

St peace College _____ / dhet _____

Assessment career job :

-application name : tshingombe tshitadi

Permit award :

N diploma certificate n saqa permit award :

Evaluation saqa vocational framework qualification nqf _____

Description practical theory requirent training trade national	yes	not
<p><u>St peace College / dhet</u></p> <p><u>Assessment career job :</u></p> <p><u>-application name : tshingombe tshitadi</u></p> <p><u>Permit award :</u></p> <p><u>N diploma certificate n saqa permit award :</u></p> <p><u>Evaluation saqa vocational framework qualification ngf :</u></p>		

1. TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING LECTURER
LEARNING WORK-INTEGRATED LEARNING:

Assessment in order

College and institute;

College and institute engineering school business study

College and institute police school, integrity

Institution accreditation seta sasseta police merest /

Integration report annual case book order public library theory relate trade
theory and report trade theory in report annual city power trade theory
bibliotheca city power tendered report annual , report mission company
industrial trade theoretical ,

In order practical trade workshop lab city workplace training artisan relate
orientation industrial

Overview vision mission focused company city municipality government
industrial

Company mission college nonprofit company design relate case conciliation
practical Manuel . Mission join contractor company force , mission trade
industrial profit target product money market , vision

Overview mission meeting mission city power meeting escom
career , department trade in theoretical practical library bibliotheca

<p>NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI ELECTRICIAN SECTOR: Electrical TRADE PRACTICAL Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032 4th Semester NSQF (LEVEL - 5) DIRECTORATE GENERAL OF TRAINING MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP GOVERNMENT OF INDIA CopyrightCopyrightCopyrightCopyrightCopyright @@@@ NIMINIMINIMINIMI NotNotNotNot toto bebebebebe RepublishedRepublishedRepublishedRepublishedRepublished (ii)</p>		
--	--	--

Sector : Electrical
Duration : 2 - Years
Trade : Electrician 4th Semester - Trade Practical - NSQF (LEVEL - 5)
Copyright@ 2018 National Instructional Media Institute, Chennai
First Edition : December 2018 Copies : 10,000

Entrepreneurship,
Government of India.
New Delhi - 110 001

General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi (NSQF) under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of

NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private

INTRODUCTION

This manual for trade practical is intended for use in the ITI workshop. It consists of a series of practical exercises that are to be completed by the trainees during the first semester of course is the Electrician trade under Electrical Sector. It is National Skills Qualifications Framework NSQF (LEVEL - 5), supplemented and supported by instructions/information to assist the trainees in performing the exercise. The exercises are designed to ensure that all the skills prescribed in the syllabus are covered including the allied trades. The syllabus for the 4th Semester Electrician Trade under Electrical Sector Trade Practical is divided into Seven Modules. The allocation of time for the various modules is given below:

Module 1 - Electronic Practice 15 Exercises 175 Hrs
 Module 2 - Control Panel Wiring 5 Exercises 100 Hrs
 Module 3 - AC/DC Motor Drives 3 Exercises 50 Hrs
 Module 4 - Inverter and UPS 6 Exercises 75 Hrs
 Module 5 - Power Generation and Substation 7 Exercises 50 Hrs
 Module 6 - Transmission and Distribution 7 Exercises 50 Hrs
 Module 7 - Circuit Breakers and Relays 5 Exercises 25 Hrs
 Total 48 Exercises 525 Hrs

The syllabus and the content in the modules are interlinked. As the number of workstations available in the electrical section is limited by the machinery and equipment, it is necessary to interpolate the exercises in the modules to form a proper teaching and learning sequence. The sequence of instruction is given in the schedule of instruction which is incorporated in the Instructor's Guide. With 25 practical hours a week of 5 working days 100 hours of practical per month is available.

Contents of Trade Practical

The procedure for working through the 48 exercises for the 4th semester with the specific objectives as the learning out comes at the end of each exercise is given in this book. The skill objectives tools/instruments, equipment/machines and materials required to perform the exercise are given in the beginning of each exercise. Skill training in the shop floor is planned through a series of practical exercises/experiments to support the related theory to make the trainees get hands on training in the Electrician trade along with the relevant cognitive skills appropriate for the level.

A minimum number of projects have been included to make the training more effective and develop attitude to work in a team. Pictorial, schematic, wiring and circuit diagrams have been included in the exercises, wherever necessary, to assist the trainees broaden their views. The symbols used in the diagrams comply with the Bureau of Indian Standards (BIS) specifications. Illustrations in this manual, help trainees visual perspective of the ideas and concepts. The procedures to be followed for completing the exercises are also given. Different forms of intermediate test questions have been included in the exercises, to enhance the trainee to trainee and trainee to instructor interactions.

Skill Information

Skill areas which are repetitive in nature are given as separate skill information sheets. Skills which are to be developed in specific areas are included in the exercises itself. Some sub exercises are developed to fulfill the sequence of exercises in keeping with the syllabus.

This manual on trade practical forms part of the Written Instructional Material (WIM), which includes manual on trade theory and assignment/test.

Copyright © NIMI Not to be Republished
(vii)

CONTENTS

Exercise No. Title of the Exercise Page No.

Module 1 : Electronic Practice

4.1.160 Determine the value of resistance by colour code and identify the types 1

4.1.161 Test active and passive electronic components and its applications 4

4.1.162 Determine the V-I characteristics of semi conductor diode 9

4.1.163 Construct half-wave, full wave and bridge rectifiers using semi conductor diode 12

4.1.164 Check transistors for their functioning by identifying its type and terminals 16

4.1.165 Bias the transistor and determine its characteristics 19

4.1.166 Use transistor as an electronic switch and series voltage regulator 21

4.1.167 Operate and set the required frequency using function generator 24

4.1.168 Make a printed circuit board for power supply 26

4.1.169 Construct simple circuits containing UJT for triggering and FET as an amplifier 30

4.1.170 Troubleshoot defects in simple power supplies 33

4.1.171 Construct power control circuit by SCR, DIAC, TRIAC and IGBT 39

4.1.172 Construct variable DC stabilized power supply using IC 43

4.1.173 Practice on various logics by use of logic gates and circuits 44

4.1.174 Generate and demonstrate wave shapes for voltage and current of rectifier,

single stage amplifier and oscillator, using CRO 49		
Module 2 : Control Panel Wiring		
4.2.175 (i) Design layout of control cabinet, assemble control elements and wiring accessories for local and remote control of induction motor 53		
4.2.175 (ii) Design layout of control cabinet, assemble control elements and wiring accessories for forward and reverse operation of induction motor 57		
4.2.175 (iii) Design layout of control cabinet, assemble control elements and wiring accessories for automatic star-delta starter with change of direction of rotation 60		
4.2.175 (iv) Design layout of control cabinet, assemble control elements and wiring accessories for sequential control of three motors 63		
4.2.176 Carryout wiring of control cabinet as per wiring diagram, bunching of XLPE cables channeling, tying and checking etc. 67		
4.2.177 Mount various control elements (e.g) circuit breakers, relays, contactors and timers etc. 69		
4.2.178 Identify and install required measuring instruments and sensors in control panel 70		
4.2.179 Test the control panel for its performance 71		
Module 3 : AC/DC Motor Drives		
4.3.180 Perform speed control of DC motor using thyristors/DC drive 72		
4.3.181 Perform speed control and reversing the direction of rotation of AC motors by using thyristors/AC drive 75		
Copyright @ NIMI Not to be Republished (viii)		
CONTENTS		
Exercise No. Title of the Exercise Page No.		
4.3.182 Construct and test a universal motor speed controller using SCR 78		
Module 4 : Inverter and UPS		
4.4.183 Assemble circuits of voltage stabilizer and UPS 81		
4.4.184 Prepare an emergency light 84		
4.4.185 Assemble circuits of battery charger and inverter 86		
4.4.186 Test analyse, defects and repair voltage stabilizer, emergency light and UPS 89		
4.4.187 Maintain service and trouble shoot battery charger and inverter 93		
4.4.188 Install an inverter with battery and connect it in domestic wiring for operation 95		
Module 5 : Power Generation and Substation		
4.5.189 Draw layout of thermal power plant and identify function of different layout element 98		
4.5.190 Draw layout of hydel power plant and identify functions of different layout elements 100		
4.5.191 Visit to transmission/distribution substation 102		

4.5.192 Draw actual circuit diagram of substation visited and indicate various components 104

4.5.193 Prepare layout plan and identify different elements of solar power system 105

4.5.194 Prepare layout plan and identify different elements of wind power system 106

4.5.195 Assemble and connect solar panel for illumination 107

Module 6 : Transmission and Distribution

4.6.196 Practice installation of insulators used in HT/LT lines for a given voltage range 110

4.6.197 Draw single line diagram of transmission and distribution system 114

4.6.198 Measure current carrying capacity of conductor for given power supply 116

4.6.199 Fasten, jumper in pin, shackle and suspension type insulators 118

4.6.200 Erect an overhead service line pole for single phase 240V distribution system in open space 120

4.6.201 Practice on laying of domestic service line 122

4.6.202 Install bus-bar and bus coupler on LT line 125

Module 7 : Circuit Breakers and Relays

4.7.203 Identify various parts of relay and ascertain the operation 127

4.7.204 Practice setting of pick up current and time setting multiplier for relay operation 129

4.7.205 Identify the parts of circuit breaker, check its operation 131

4.7.206 Test tripping characteristic of circuit breaker for over current and short circuit current 133

4.7.207 Practice on repair and maintenance of circuit breaker 135

Project Work 138

ASSESSABLE / LEARNING OUTCOME

On completion of this book you shall be able to

- Detect the faults and troubleshoot inverter
- Plan, assemble and install a solar panel
- Erect an overhead domestic service line and outline various power plant layout.
- Examine the faults and carryout repairing of circuit breakers.
- Identify the control and functional switches in a C.R.O and measure the DC and AC voltage, frequency time period.
- Construct and test a half and fullwave rectifiers with and without filter circuits.
- Draw and wire up the control panel for forward/ reverse operation of an induction motor.
- Control speed and reverse the direction of rotation of different type of three phase induction motor using VVVF control /AC drive

Copyright @ NIMI Not to be Republished

(x)

ELECTRICIAN 4TH SEMESTER SYLLABUS

Fourth Semester Duration: Six Month

Week

No. Learning outcome Reference Professional Skills (Trade Practical) With Indicative Hours Professional Knowledge (Trade Theory) • Assemble simple electronic circuits and test for functioning. 160. Determine the value of resistance by colour code and identify types. (10 Hrs) 161. Test active and passive electronic components and its applications. (15 Hrs) 79 Resistors - colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory. 80-81 • Assemble simple electronic circuits and test for functioning. 162. Determine V-I characteristics of semiconductor diode. (10 Hrs) 163. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (10 Hrs) 164. Check transistors for their functioning by identifying its type and terminals. (10 Hrs) 165. Bias the transistor and determine its characteristics. (10 Hrs) 166. Use transistor as an electronic switch and series voltage regulator. (10 Hrs) P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier. 82-83 • Assemble simple		
--	--	--

**Electronic circuits
and test for
functioning.**

**167. Operate and set the required
frequency using function generator.
(12 Hrs)**

**168. Make a printed circuit board for
power supply. (10 Hrs)**

**169. Construct simple circuits containing
UJT for triggering and FET as an
amplifier. (12 Hrs)**

**170. Troubleshoot defects in simple
power supplies. (16 Hrs)**

**Basic concept of power electronics
devices.**

IC voltage regulators

**Digital Electronics - Binary numbers,
logic gates and combinational circuits.**

**84-85 • Assemble simple
electronic circuits
and test for
functioning.**

**171. Construct power control circuit by
SCR, Diac, Triac and IGBT. (15 Hrs)**

**172. Construct variable DC stabilized
power supply using IC. (10 Hrs)**

**173. Practice on various logics by use
of logic gates and circuits. (15 Hrs)**

**174. Generate and demonstrate wave
shapes for voltage and current of
rectifier, single stage amplifier and
oscillator using CRO. (10 Hrs)**

**Working principle and uses of
oscilloscope.**

**Construction and working of SCR, DIAC,
TRIAC and IGBT.**

**Principle, types and applications of
various multivibrators.**

**86-87 • Assemble
accessories and
carry out wiring
of control
cabinets and
equipment.**

**175. Design layout of control cabinet,
assemble control elements and
wiring accessories for:**

**(i) Local and remote control of
induction motor. (15 Hrs)**

**(ii) Forward and reverse operation
of induction motor. (10 Hrs)**

<p>Study and understand Layout drawing of control cabinet, power and control circuits.</p> <p>Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc.</p> <p>Copyright @ NIMI Not to be Republished (xi)</p> <p>ELECTRICIAN 4TH SEMESTER SYLLABUS</p> <p>Fourth Semester Duration: Six Month Week</p> <p>No.</p> <p>Learning outcome</p> <p>Reference</p> <p>Professional Skills (Trade Practical)</p> <p>With Indicative Hours</p> <p>Professional Knowledge (Trade Theory)</p> <p>(iii) Automatic star-delta starter with change of direction of rotation. (15 Hrs)</p> <p>(iv) Sequential control of three motors. (10 Hrs)</p> <p>88-89 • Assemble accessories and carry out wiring of control cabinets and equipment.</p> <p>176. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channeling, tying and checking etc. (15 Hrs)</p> <p>177. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (10 Hrs)</p> <p>178. Identify and install required measuring instruments and sensors in control panel. (10 Hrs)</p> <p>179. Test the control panel for its performance. (15 Hrs)</p> <p>Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties, sleeves, gromats and clips etc.</p> <p>Testing of various control elements and circuits.</p> <p>90-91 • Perform speed</p>		
---	--	--

control of AC
and DC motors
by using solid
state devices.

180. Perform speed control of DC motor
using thyristors / DC drive. (18 Hrs)

181. Perform speed control and
reversing the direction of rotation
of AC motors by using thyristors /
AC drive. (18 Hrs)

182. Construct and test a universal
motor speed controller using SCR.
(14 Hrs)

Working, parameters and applications of
AC / DC drive.

Speed control of 3 phase induction motor
by using VVVF/AC Drive.

92-94 • Detect the faults
and troubleshoot
inverter, stabilizer,
battery charger,
emergency light
and UPS etc.

183. Assemble circuits of voltage
stabilizer and UPS. (15Hrs)

184. Prepare an emergency light.
(10 Hrs)

185. Assemble circuits of battery
charger and inverter. (15 Hrs)

186. Test, analyze defects and repair
voltage stabilizer, emergency light
and UPS. (15 Hrs)

187. Maintain, service and troubleshoot
battery charger and inverter.
(10 Hrs)

188. Install an Inverter with battery and
connect it in domestic wiring for
operation. (10 Hrs)

Basic concept, block diagram and
working of voltage stabilizer, battery
charger, emergency light, inverter and
UPS.

Preventive and breakdown maintenance.

95 • Erect overhead
domestic service
line and outline
various power
plant layout.

189. Draw layout of thermal power plant
and identify function of different
layout elements. (5 Hrs)

<p>190. Draw layout of hydel power plant and identify functions of different layout elements. (5 Hrs) Conventional and nonconventional sources of energy and their comparison. Power generation by thermal and hydel power plants. Copyright @ NIMI Not to be Republished (xii) ELECTRICIAN 4TH SEMESTER SYLLABUS Fourth Semester Duration: Six Month Week No. Learning outcome Reference Professional Skills (Trade Practical) With Indicative Hours Professional Knowledge (Trade Theory)</p> <p>191. Visit to transmission / distribution substation. (10 Hrs)</p> <p>192. Draw actual circuit diagram of substation visited and indicate various components. (5 Hrs)</p> <p>96 • Plan, assemble and install solar panel. • Erect overhead domestic service line and outline various power plant layout.</p> <p>193. Prepare layout plan and Identify different elements of solar power system. (05 Hrs)</p> <p>194. Prepare layout plan and Identify different elements of wind power system. (05 Hrs)</p> <p>195. Assemble and connect solar panel for illumination. (15 Hrs) Various ways of electrical power generation by non-conventional methods. Power generation by solar and wind energy. Principle and operation of solar panel.</p> <p>97 • Erect overhead domestic service line and outline various power plant layout.</p>		
---	--	--

<p>196. Practice installation of insulators used in HT/LT line for a given voltage range. (5 hrs)</p> <p>197. Draw single line diagram of transmission and distribution system. (5 Hrs)</p> <p>198. Measure current carrying capacity of conductor for given power supply. (5 hrs)</p> <p>199. Fasten jumper in pin, shackle and suspension type insulators. (10 Hrs)</p> <p>Transmission and distribution networks. Line insulators, overhead poles and method of joining aluminum conductors.</p> <p>98 • Erect overhead domestic service line and outline various power plant layout.</p> <p>200. Erect an overhead service line pole for single phase 230 V distribution system in open space. (10 Hrs)</p> <p>201. Practice on laying of domestic service line. (10 Hrs)</p> <p>202. Install bus bar and bus coupler on LT line. (5 Hrs)</p> <p>Safety precautions and IE rules pertaining to domestic service connections.</p> <p>Various substations. Various terms like - maximum demand, average demand, load factor, diversity factor, plant utility factor etc.</p> <p>99 • Examine the faults and carry out repairing of circuit breakers.</p> <p>203. Identify various parts of relay and ascertain the operation. (5 Hrs)</p> <p>204. Practice setting of pick up current and time setting multiplier for relay operation. (5 hrs)</p> <p>205. Identify the parts of circuit breaker, check its operation. (5Hrs)</p> <p>206. Test tripping characteristic of circuit breaker for over current and short circuit current. (5 hrs)</p> <p>207. Practice on repair and maintenance of circuit breaker. (5 hrs)</p>		
--	--	--

<p>Types of relays and its operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching. Copyright @ NIMI Not to be Republished (xiii) ELECTRICIAN 4TH SEMESTER SYLLABUS Fourth Semester Duration: Six Month Week No. Learning outcome Reference Professional Skills (Trade Practical) With Indicative Hours Professional Knowledge (Trade Theory) 100-101 Project work / Industrial visit Broad Areas: a) Battery charger/Emergency light b) Control of motor pump with tank level c) DC voltage converter using SCRs d) Logic control circuits using relays e) Alarm/indicator circuits using sensors 102-103 Re Electrical Exercise 4.1.160 Electrician - Electronic Practice Determine the value of resistance by colour code and identify the types Objectives: At the end of this exercise you shall be able to <ul style="list-style-type: none"> • identify the types of resistors by referring to the pictorial representation • identify the colour bands, and decode the resistance value • calculate the tolerance value by the colour band • measure the actual value with an ohmmeter verify with calculated value. Requirements Tools/Instruments <ul style="list-style-type: none"> • Multimeter/Ohmmeter - 1 No. Materials <ul style="list-style-type: none"> • Various types of resistors (assorted values) including potentiometers of carbon track and wire-wound type. - as reqd PROCEDURE TASK 1: Identify the type of resistor from pictorial representation 1 Identify the resistor's type by referring Fig 1 and write the type in Table 1. </p>		
--	--	--

2 Sketch the I.S. symbol for the identified resistor i

TASK 2 : Identify the colour band and decode the resistance value

1 Identify the value of resistors shown in Fig 2 from the colour bands and enter Table 2.

2 Identify the first two colour bands of the resistors given by the instructor (in sequence commencing from the 1st colour band closer to one end of the resistor - Refer Fig 3.

3 Write the 1st number and 2nd number in Table 2.

4 Identify the colour of the 3rd band and write the multiplier value in the respective column in Table 2.

5 Compute the value of the resistor and record in Table 2.

6 Identify the 4th band colour and fill up the tolerance in Table 2.

7 Determine the resistance value and the tolerance for the another given resistors and record in Table 3 by repeating the above steps 1 to 6.

8 Measure the value of the resistors by using a multimeter/ohmmeter and enter the values in Table 3 by following the procedure given below.

Sl.N o.	Colo ur	1	2	3	4	Multip lie	Resista nce value	Temperat ure
------------	------------	---	---	---	---	---------------	-------------------------	-----------------

Connect the probes

i Connect the red probe to the POSITIVE terminal

ii Connect the black probe to the COMMON terminal

b Set the multimeter/ohmmeter (Fig 4)

i Set the range selector switch to one of the ohm range.
 c Conduct zero ohm adjustment in analog multimeter
 i Short-circuit the two probes at the selected range.
 ii Turn the ohm adjustment knob until the pointer is set at zero ohm. (zero adjustment)
 d Connect the resistor to be measured.
 i Keep your finger tips off from the probes.
 ii Maintain firm contact with the resistor lead wires.
 e Read the meter
 i Use a range which deflects the pointer to middle of the scale (Fig 5)
 Copyright © NIMI Not to be Republished

3
 iv In Fig 4, the resistance range x 100 is selected, if so the value of the resistance is $15 \times 100 = 1500$ ohms = 1.5 (K Ohm)
 9 Enter the marked value of resistance and tolerance (by the colour band over the resistor) in Table 3.
 10 Calculate the minimum and maximum values of actual resistance for each resistor considering the tolerance marked over it. (Table 3) Record the values in Table 3.
 11 Determine the acceptability (OK or not OK) by comparing the measured value with the minimum and maximum of the indicated value.

Note : Each range selection zero adjustment is to be ensured for correct value of resistance.

Table 3

Sl.No.	Band 1st	Band 2nd	Band 3rd	Band 4th	Recorded resistance in Ohm	Tolerance %	Max. value of resistance	Min. value of resistance	Measured value of resistance	Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

%

1

2

3

4

5

6

7

8

9

10

12 Report and get it checked by your instructor.

Electrical : Electrician (NSQF LEVEL - 5) - Exercise 4.1.160

ii Read the meter in the Ohm scale right above the pointer. (In this case 15 as shown in Fig 5)

iii Resistance = (Ohm scale reading) x (Magnification

at selected range of the resistance range).

Copyright @ NIMI Not to be Republished

4

Electrical Exercise 4.1.161

Electrician - Electronic Practice

Test active and passive electronic components and its applications

Objectives: At the end of this exercise you shall be able to

- **identify the electronic components - diode, diode bridge, transistor, SCR, IC by referring to the pictorial representation**
 - **identify the given electronic components- diode, diode bridge, selenium bridge, transistor, IC, by visual inspection**
 - **read the symbols for active components in the given circuit diagram**
 - **identify the active components and their base diagram, lead configuration by referring to the data book by component code number**
 - **decode and name the semi conductor devices - diodes transistors, SCRs**
 - **identify the passive components by visual inspection**
 - **interpret the coding and marking on the components**
 - **test the components for its working conditions.**
- Requirements**

Tools/Instruments

- **Multimeters/Ohmmeter - 1 No.**

Materials/Components

- **Capacitors, inductors, resistors (assorted size, shape and values) - as reqd.**
- **Assorted components of diodes, transistors, SCRs, DIACs, TRIACs, UJTs, FETs bridge diodes etc of different types with semi-conductor data manual - as req**

TASK 1: Identify the active components

Assumption: Given components have their code number, lead identification marks are available in data book

1 Look at the Fig 1. Identify the component from the pictorial representation. Give your response in Table 1.

2 Write the figure Nos. that indicate the components given in Fig 2, in Table 2

Table 1

Sl.No. Figure number Component's name

1 Fig 1 a

2 Fig 1 b

3 Fig 1 c

<p>3 signal from microcontroller *X823750113* page 13MARKS DO NOT WRITE IN THIS MARGIN 9. (continued) (a) Describe the operation of the circuit shown opposite. When a signal is received from the microcontr ir at a pressure of 0.32 N mm⁻² is supplied to cylinder B . This results in an outstroking force of 620 N. (b) (i) Calculate the area of the piston. (ii) Calculate the diameter of the piston.</p> <p>3 3 *X823750115* page 15MARKS DO NOT WRITE IN THIS MARGIN 9. (continued) A microcontroller based system is used to detect the bottles. The program used to count six bottles is shown below. line program 1 main: let count = 0 2 check: if input2 is off then check 3 let count = count + 1 4 if count = 6 then label_1 5 goto check 6 label_1: switch on 7 7 pause 500 8 switch off 7 9 goto main (c) State the line number that contains a time delay. An incomplete diagram for the microcontroller based system is shown below. (d) Complete, with reference to the program above, the wiring of the bottle sensor and the transistor to the microcontroller.</p> <p>3 2 1 0 4 5 6 7 bottle sensor</p>		
---	--	--

5 V

0 V

12 V

signal to
pneumatic
circuit

[Turn over

1

2

X823750116

page 16

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE

X823750118

page 18MARKS DO NOT

WRITE IN

THIS

MARGIN

10. (continued)

Part of the circuit used in the warning sign is shown below.

390 Ω 82 Ω

78 Ω

86 Ω

(d) (i) Calculate the resistance of the three LEDs in parallel. The warning sign is rated at 12 V, 1.8 W.

(e) Calculate the current supplied to the warning sign.

[Turn over

3

X823750120

page 20MARKS DO NOT

WRITE IN

THIS

MARGIN

11. The mountain coaster shown below allows riders to travel downhill in an unpowered carriage. The rider can control the speed of the carriage by using a braking system.

support

structure

carriage

track

wheelsbrake lever

A number of different engineers were involved during the development and

construction of the mountain coaster.

(a) (i) Describe a task that a mechanical engineer would carry out during the development of the carriage.

(ii) Describe a task that a civil engineer would carry out during the development of the mountain coaster.

(iii) Describe a task that an environmental engineer would carry out during the construction of the track.

1

1

1

X823750121

page 21 MARKS DO NOT

WRITE IN

THIS

MARGIN

11. (continued)

At the start of the ride, 6.2 m above the ground, the carriage and rider have a

combined potential energy of 13 kJ.

(b) (i) Calculate the combined mass of the carriage and rider.

(ii) Calculate the kinetic energy of the carriage and rider when released and

travelling at a velocity of 2.7 m s⁻¹.

[Turn over

3

2

X823750122

page 22 MARKS DO NOT

WRITE IN

THIS

MARGIN

11. (continued)

A structural engineer analyses the forces acting through part of the support

structure for the track.

A triangle of forces diagram used in the analysis is shown below.

2500 N

2600 N

scale: 10 mm = 500 N

F

(c) Determine, with reference to the triangle of forces diagram, the size of

unknown force F.

F = N

The properties of the four metals considered for the support structure are shown in

the table below.

Metal Corrosion

resistant Durability

A no low

B yes high

C yes low

D no high

(d) Select the most suitable metal (A-D) from the table above to be used for the

support structure and justify your choice

Choice of metal

Justification

1

2

X823750123

page 23 MARKS DO NOT

WRITE IN

THIS

MARGIN

12. A washing machine is shown.

A sub-system diagram showing the control of the water temperature in the washing

machine is shown below.

temperature

sensor

output

driver

control heating

element

actual water

temperature

system

boundary

set water

temperature

(a) Describe the reason for including a system boundary in a sub-system diagram.

(b) Describe, with reference to the sub-system diagram above, the control of the water temperature.

The water temperature is set . . .

1

3

[Turn over

X823750124

page 24 MARKS DO NOT

WRITE IN

THIS

MARGIN

12. (continued)

A thermistor is used in the temperature sensor.

The operating characteristics of six thermistors are shown on the graph below.

-75 -50 -25 0 25 50 75 100 125 150 200 250 300

2

2

2

2

2

2

2

3
3
3
3
3
3
5
5
5
5
5
5
8
8
8
8
8
8
1
2
3
4 6
5
10
100
1k
10k
100k
1M
10M
temperature (°C)
resistance (Ω)
(c) State the thermistor number from the graph above that has a
resistance of
1 kΩ when the temperature is 30 °C. 1
X823750125
page 25MARKS DO NOT
WRITE IN
THIS
MARGIN
12. (continued)
(d) Explain why using a low temperature wash cycle can affect climate
change.
The washing machine's heating element is tested using 8.6 kg of
water.
(e) Calculate the heat energy when the water temperature is raised by
15 °C.
[Turn over
2
2
X823750126

page 26 MARKS DO NOT
WRITE IN
THIS
MARGIN

12. (continued)

The logic diagram for part of a circuit used in the washing machine is shown.

A

B Z

D

C

(f) Complete the truth table for this logic diagram.

A B C D Z

0 0

0 1

1 0

1 1

The truth table for another logic circuit in the washing machine is shown below.

F G H Y

0 0 0 0

0 0 1 0

0 1 0 0

0 1 1 0

1 0 0 0

1 0 1 1

1 1 0 1

1 1 1 0

(g) Complete the Boolean equation for output Y in terms of inputs F, G and H

O NOT WRITE ON THIS PAGE

X823750128

page 28 MARKS DO NOT

WRITE IN

THIS

MARGIN

13. A combine harvester used to gather crops is shown below.

cutter bar

reel

(a) State the type of motion shown above at the:

reel

cutter bar

A simplified diagram for the combine harvester is shown.

32 kN 82 kN

2.4 m 1.8 m

RA RB

2.6 m

front wheel back wheel

2

X823750129

page 29 MARKS DO NOT

**WRITE IN
THIS
MARGIN**

13. (continued)

(b) (i) Calculate the reaction force RA by taking moments about RB.

(ii) Calculate the reaction force RB.

[Turn over

3

2

X823750130

page 30MARKS DO NOT

WRITE IN

THIS

MARGIN

13. (continued)

Part of a drive mechanism used in the combine harvester is shown.

gear B

50 teeth

gear D

gear A

10 teeth

gear C

12 teeth

output

250 revs min⁻¹

input

3750 revs min⁻¹

(c) Calculate the number of teeth on gear D. 4

X823750131

page 31MARKS DO NOT

WRITE IN

THIS

MARGIN

13. (continued)

The combine harvester uses a Global Positioning System (GPS) when cutting the

crop. This is an established technology.

An emerging technology is one that is new and still to be tried

commercially within

a product or system.

(d) Explain a possible impact of an emerging technology which you are familiar

with.

Emerging technology

Impact

[Turn over

2

X823750132

page 32MARKS DO NOT

WRITE IN

THIS

MARGIN

14. A laminator is used to cover a sheet of paper in a plastic sleeve. The plastic sleeve is heated by the laminator as it passes through. The circuit used to indicate when the laminator is at the correct temperature is shown below.

green

V_{in}

red

input sub-system +V

–t°

0 V

V_s

(a) Describe the operation of the input sub-system as the temperature increases.

Make reference to the resistance of the thermistor and the voltage V

As the temperature increases . . .

2

X823750133

page 33 MARKS DO NOT

WRITE IN

THIS

MARGIN

14. (continued)

The input sub-system is shown below.

–t°

0 V

5.0 V

1.9 V 1.7 kΩ

(b) Calculate the resistance of the thermistor for the condition shown above.

(c) Describe, with reference to the circuit shown opposite, the effect on the red

LED and the green LED when the transistor first activates the relay.

When the transistor activates the relay . . .

4

2

[Turn over

X823750134

page 34 MARKS DO NOT

WRITE IN

THIS

MARGIN

14. (continued)

A possible modification to the circuit is to include an audible alert when the

laminator is at the correct temperature.

(d) Draw, in the circuit below, the symbol for a buzzer connected in parallel with

the green LED.

green

red

+V

2

X823750135

page 35 MARKS DO NOT

WRITE IN

THIS

MARGIN

14. (continued)

An electronic engineer used computer simulation to test the modified circuit.

(e) Describe an advantage of using computer simulation compared to building a circuit for testing purposes.

A large reduction in speed is required for a feed roller to slowly move the plastic

sleeve and paper through the laminator.

(f) Explain why a compound gear train is more suitable than a simple gear train to

create this large reduction in speed in the laminator.

[END OF QUESTION PAPER]

1

2

X823750136

page 36 MARKS DO NOT

WRITE IN

THIS

MARGIN

ADDITIONAL SPACE FOR ANSWERS

X823750137

page 37 MARKS DO NOT

WRITE IN

THIS

MARGIN

ADDITIONAL SPACE FOR ANSWERS

X823750138

page 38

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE

X823750139

page 39

[BLANK PAGE]

**National
Qualifications
2019**

2019 Engineering Science

National 5

Finalised Marking Instructions

© Scottish Qualifications Authority 2019

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

The information in this document may be reproduced in support of SQA qualifications only on a non-commercial basis. If it is reproduced, SQA must be clearly acknowledged as the source. If it is to be reproduced for any other purpose, written permission must be obtained from permissions@sqa.org.uk.

©

page 02

General marking principles for National 5 Engineering Science

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) Where a candidate makes an error at an early stage in a multi-stage calculation, credit should normally be given for correct follow-on working in subsequent stages, unless the error significantly reduces the complexity of the remaining stages. The same principle should be applied in questions which require several stages of nonmathematical reasoning.

(c) All units of measurement will be presented in a consistent way, using negative indices where required (eg ms^{-1}). Candidates may respond using this format, or solidus format (m/s) or words (metres per second), or any combination of these (eg metres/second).

page 03

Marking instructions for each question

Section 1

Question Expected response Max mark Additional guidance

1. (a) 2 1 mark for electrical as input.

1 mark for heat as output.

Do not accept electricity/electric.

(b) Closed loop (control) 1 Do not accept closed on its own.

(c) 1 1 mark for correct symbol.

-t^o not required.

Small line must be parallel to long side of resistor.

Do not accept an arrow on any end.

2.E

P t

=6750

270

P =

P = 25

P = 25 W (2 sf)

2

1 mark for substitution.

1 mark for correct answer from given working with unit.

3. (a) Air that operates a piston/cylinder. 1 Descriptive response of function.

Accept instroke/outstroke/actuate a cylinder.

Must specifically refer to operating (stated or inferred) a cylinder/piston.

(b) Air used to actuate a valve. 1 Descriptive response of function.

Must specifically refer to operating (stated or inferred) a valve.

page 04

Question Expected response Max mark Additional guidance

4. (a)Speed of Input

Velocity Ratio Speed of Output

=800

Velocity Ratio 320

=

Velocity Ratio = 5 : 2

2

1 mark for substitution.

1 mark for correct answer from given working.

Accept 2.5 : 1 or 2.5

Ignore any units.

(b) Anti-clockwise. 1 Do not accept other way or opposite way.

Accept indication of direction on diagram.

<p>5. (a) (i) Civil. 1 (ii) Environmental. 1 (b) Less stressful journeys . Journey time quicker. City roads less congested. Areas bypassed will be quieter/safer. City will be less polluted to live in. Jobs created in the construction of the bypass/of housing in outlying areas. 2 1 mark for each descriptive response of positive social impact of a city bypass. Assume impact refers to bypass unless indicated in response. Do not accept quick on its own. Do not accept less congestion on bypass.</p> <p>6. 3 1 mark for NOT gate wired to input B. 1 mark for OR gate wired to A and (NOT) B. 1 mark for AND gate wired to input C and A (OR) B. No FTE from gate.</p> <p>page 08 Question Expected response Max mark Additional guidance</p> <p>9. (a) 1 Dashed box around process. (b) The pre-set position is selected... The control unit compares the pre- set position with the actual position. The bed/motor will start to move (if it is not in the desired position). When the desired position is detected the motor will stop.</p> <p>3 1 mark for comparison by control unit of positional sensor signal to pre-set value. 1 mark for motor starting. 1 mark for motor stopping in relation to desired position.</p> <p>(c) When an appropriate input signal is applied to the base an output current will flow at the collector/emitter. 2 1 mark for input signal at base (cause). Accept voltage as signal. 1 mark for output current at</p>		
---	--	--

collector/emitter based on given cause (effect).

(d) $Z = (A \cdot B) + (A \cdot B)$ 3 1 mark ($A \cdot B$) with brackets.

1 mark ($A \cdot B$) with brackets.

1 mark for OR-ing all statements.

If just a single statement is given then bracket not required.

accept alternatives such as

$Z = A + B$

$Z = (A+B) + (A \cdot B)$

(e) G H Y

0 1 1

0 1 1

0 1 1

0 1 1

0 1 1

0 1 1

1 0 0

1 0 1

3

1 mark per correct complete column.

Allow for follow through error.

Column H = NOT G..

Column Y = F OR.

page 09

Question Expected response Max mark Additional guidance

10. (a) Saw blade: rotary.

Pneumatic piston: reciprocating.

2 1 mark for saw blade motion.

1 mark for piston motion.

Accept rotational/reciprocal.

Do not accept rotating.

(b) When an increase in pressure is detected by valve 3...

...and when valve 1 is actuated (air is sent actuating valve 4), causing the piston to instroke...

valve 7 is actuated then there is a time delay...

...then valve 4 actuates causing the piston to outstroke.

3

1 mark for AND control with valve 1 and 3 causing the piston to instroke.

1 mark for time delay after valve 7 being actuated.

1 mark piston outstroke after valve 4 actuated and valve 7/time delay.

(c) 1 X on lower pipe to double acting

cylinder.
 Accept X on the bottom exhaust port of the 5/2 valve.
 (d) The control of the piston movement could be easily changed/updated.
 The piston time delay could be easily changed/shortened.
 The piston time delay could be more consistent/accurate.
 1 Descriptive response relating to advantage of microcontroller control of piston movement.
 Do not accept fewer components or cost savings.
 page 10
 Question Expected response Max mark Additional guidance
 10. (e) (i) 2
 d
 Apiston 4
 π
 $= \cdot \times$
 $= =$
 2
 3 14 88
 Apiston 6079
 4
 (mm²)²
 d
 Arod 4
 π
 $= \cdot \times$
 $= = \cdot$
 2
 3 14 24
 Arod 452 2
 4
 (mm²)
 Aeffective = Apiston - Arod
 Aeffective = 6079 - 452•2
 Aeffective = 5627
 Aeffective = 5600 mm² (2 sf)
 3
 1 mark for area of rod (unit not required).
 1 mark for area of piston (unit not required).
 1 mark for correct subtraction answer with unit.
 Using the π function will give different intermediary values (6082 and 452•4) but same final answer to 2 sf.

<p>(ii)F P A =F 0 20 5600 · = F = 0•20 x 5600 F = 1120 F = 1•1 kN (2 sf) 3 1 mark for substitution Allow FTE from part (e)(i). 1 mark for transposition. 1 mark for correct answer from given working with unit. page 11 Question Expected response Max mark Additional guidance 11. (a) (i) $\Sigma CWM = \Sigma ACWM$ (RA x 2•4) = (680 x 0•4) + (930 x 3•6)A 3620 R 2 4 = · RA = 1508 RA = 1•5 kN (2 sf) 3 1 mark for substitution. 1 mark for transposition. 1 mark for correct answer from given working with unit. (ii) $\Sigma F_{vertical} = 0$ 930 + 680 = 1500 + RB RB = 1610 - 1500 RB = 110 RB = 110 N (2 sf) 2 1 mark for substitution Allow FTE from part a(i). 1 mark for correct answer from given working with unit. If moments used to determine RB then accepted 101•7 N . (b) Equilibrium. 1 Ignore additional description (c)F A = $\sigma 2500$ 0 06 A · =2500 0 06 A = · A = 41670 A = 42000 mm² (2 sf) 3</p>		
---	--	--

1 mark for substitution.. 1 mark for transposition. 1 mark for correct answer from given working with unit. (d) Design how to connect the visitor centre to the national grid. Calculate the electrical power requirements of the visitor centre. Select appropriately rated cables. Calculate the lighting requirements/ plan the lighting layout. 2 1 mark for any appropriate descriptive response of an engineer's task (design/calculate/select/model...) and the electrical aspect (must be linked to design of visitor centre). Not design a circuit/wiring on its own. Not electronic or electrician related.		

his qualification replaces:

Qual ID	Qualification Title	Pre-2009 NQF Level	NQF Level	Min Credits	Replacement Status
63889	Further Education and Training Certificate: Electrical Engineering	Level 4	NQF Level 04	130	Complete
72072	Further Education and Training Certificate: Electrical Engineering: Chemical	Level 4	NQF Level 04	130	Complete
72070	Further Education and Training Certificate: Electrical Engineering: Electrical Construction	Level 4	NQF Level 04	130	Complete
23625	National Certificate: Electrical	Level 4	Level TBA: Pre-2009 was L4	301	Complete
20420	National Certificate: Electrical	Level 4	NQF Level	120	Complete

	Engineering		04		
20418	National Certificate: Electrical Engineering	Level 2	NQF Level 02	120	Complete
48474	National Certificate: Electrical Engineering	Level 4	Level TBA: Pre-2009 was L4	134	Complete
48473	National Certificate: Electrical Engineering	Level 2	NQF Level 02	143	Complete
63790	National Certificate: Electrical Engineering	Level 3	NQF Level 03	133	Complete
48475	National Certificate: Electrical Engineering	Level 3	NQF Level 03	127	Complete
20419	National Certificate: Electrical Engineering	Level 3	NQF Level 03	120	Complete
63789	National Certificate: Electrical Engineering	Level 2	NQF Level 02	140	Complete
72074	National Certificate: Electrical Engineering: Chemical	Level 3	NQF Level 03	133	Complete
67431	National Certificate: Electrical Engineering: Chemical	Level 2	NQF Level 02	140	Complete
72073	National Certificate: Electrical Engineering: Electrical Construction	Level 3	NQF Level 03	133	Complete
67430	National Certificate: Electrical Engineering: Electrical Construction	Level 2	NQF Level 02	140	Complete
72071	National Certificate: Electrical Engineering: Mining	Level 3	NQF Level 03	133	Complete
67429	National Certificate: Electrical Engineering: Mining and Minerals	Level 2	NQF Level 02	140	Complete
72080	National Certificate: Electrical Engineering: Transport	Level 3	NQF Level 03	133	Complete
67434	National Certificate: Electrical Engineering: Transport	Level 2	NQF Level 02	140	Complete

PURPOSE AND RATIONALE OF THE QUALIFICATION

Purpose:

The purpose of this qualification is to prepare a learner to operate as an Electrician.

Electricians plan, prepare install, test, connect, commission, maintain, alter and repair electrical equipment, wiring and control systems and apply the knowledge and skills obtained, in a variety of contexts.

A qualified learner will be able to:

- ☐ Plan and prepare work site, equipment, tools, consumables and materials for electrical activities and operations.

- Install, wire and connect electrical equipment and control systems.
- Test and inspect electrical equipment, control systems and installations.
- Commission control systems and installations.
- Maintain and repair electrical equipment, control systems and installations.

Rationale:

The Occupational Certificate: Electrician was developed with the full participation of the Metal and Chemical Industries, Mining, Railways, Electrical Contractors Authority, Agricultural Sector, Eskom, South African Navy, Further Education and Training Colleges and Municipalities. The development of this qualification will ensure that the training of Artisan learners will consistently produce Artisans that can fully function within all the sectors mentioned. Once qualified the mobility of Artisans between sectors will significantly be improved.

The entry requirements of the Qualification will allow learners leaving the general schooling system after Grade 9 to gain access to the qualification. Electricians qualified through this qualification will be able to plan, prepare, install, maintain, commission and fault find a range of equipment and systems within a variety of electrical installations in the construction, manufacturing, chemical, energy, mining, municipal, agricultural and railway environments. The work experience modules were written to reflect all the different contexts that were prevalent in the various sectors and is aimed at producing an individual that is fully competent within the range of this curriculum.

Knowledge Modules:

- Health, Safety, Quality and Legislation, NQF Level 4, 5 Credits.
- Tools, Equipment and Materials, NQF Level 4, 8 Credits.
- Electricity and Electronics, NQF Level 4, 13 Credits.
- Industry Context, NQF Level 3, 2 Credits.
- Wireways and Wiring, NQF Level 4, 11 Credits.
- Rotating Electrical Machinery, NQF Level 4, 13 Credits.
- Electrical Supply Systems and Components, NQF Level 4, 31 Credits.
- Low Voltage Protection, NQF Level 4, 5 Credits.
- Fault Finding, NQF Level 4, 3 Credits.

Total number of Credits for Knowledge Modules: 91.

Practical Skill Modules:

- Use hand and power tools, NQF Level 3, Credits 22.
- Plan and prepare the process for the wiring, connection, testing, inspecting, commissioning and maintaining electrical installations and control systems, NQF Level 3, 5 Credits.
- Prepare worksite set up for installing, wiring and connecting electrical equipment and control systems, NQF Level 3, 3 Credits.
- Install wireways, NQF Level 4, 5 Credits.
- Install, wire and connect electrical equipment and control systems, NQF Level 4, Credits 38.
- Conduct pre-commission inspection (power on and off) fault find and test new and existing installations, NQF Level 4, Credits 5.
- Carry out commissioning tests, NQF Level 4, Credits 13.
- Fault find and repair electrical control systems and electrical installations, NQF Level 4, Credits 22.

Total number of Credits for Practical Skill Modules: 113.

This qualification also requires the following Work Experience Modules:

- Planning and preparation process for the wiring, connecting, testing, inspecting, commissioning and maintaining of electrical installations and control systems, NQF Level 4, Credits 8.
- Processes of installation, wiring and connection of electrical equipment and control systems, NQF Level 4, Credits 74.
- Processes of testing and inspecting of electrical equipment, control systems and installations, NQF Level 4, 15 Credits.
- Processes of commissioning electrical installations and control systems, NQF Level 4, 15 Credits.
- Maintenance processes for electrical installations and control systems, NQF Level 4, 44 Credits.

UNIT STANDARDS:

	ID	UNIT STANDARD TITLE	PRE-2009 NQF LEVEL	NQF LEVEL	CREDITS
Core	115230	Demonstrate knowledge of electrical and electronic components	Level 2	NQF Level 02	3
Core	115234	Demonstrate knowledge of electrical safe working practices	Level 2	NQF Level 02	2
Core	113877	Understand fundamentals of electricity	Level 2	NQF Level 02	8
Core	7427	Use and maintain hand tools and equipment	Level 2	NQF Level 02	3
Core	10270	Construct Basic Electronic Circuits	Level 3	NQF Level 03	4
Core	253074	Demonstrate an understanding of basic digital circuits	Level 3	NQF Level 03	6
Core	253054	Perform basic electrical circuit calculations	Level 3	NQF Level 03	10
Core	253094	Perform electronic fault-finding	Level 3	NQF Level 03	3
Core	253334	Test and replace basic electronic components	Level 3	NQF Level 03	15
Core	114406	Understand basic electronic theory and components	Level 3	NQF Level	4

				03	
Fundamental	119472	Accommodate audience and context needs in oral/signing communication	Level 3	NQF Level 03	5
Fundamental	9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	Level 3	NQF Level 03	2
Fundamental	9013	Describe, apply, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts	Level 3	NQF Level 03	4
Fundamental	119457	Interpret and use information from texts	Level 3	NQF Level 03	5
Fundamental	9012	Investigate life and work related problems using data and probabilities	Level 3	NQF Level 03	5
Fundamental	119467	Use language and communication in occupational learning programmes	Level 3	NQF Level 03	5
Fundamental	7456	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	Level 3	NQF Level 03	5
Fundamental	119465	Write/present/sign texts for a range of communicative contexts	Level 3	NQF Level 03	5
Elective	12035	Apply personal safety practices on a wastewater treatment works	Level 2	NQF Level 02	4
Elective	113863	Apply soldering techniques	Level 2	NQF Level 02	2
Elective	114605	Carry out soldering and de-soldering procedures	Level 2	NQF Level 02	3
Elective	14928	Demonstrate knowledge of basic concepts of telecommunications	Level 2	NQF Level 02	7
Elective	337140	Adjust and maintain the production/assembly process	Level 3	NQF Level 03	7
Elective	9532	Demonstrate basic knowledge of computers	Level 3	NQF Level 03	6
Elective	24450	Describe and explain the principles	Level 3	NQF	6

	4	of logistics support in a specific context		Level 03	
Elective	115242	Draw and interpret electrical diagrams	Level 3	NQF Level 03	3
Elective	115245	Fabricate aircraft electrical looms and harnesses	Level 3	NQF Level 03	10
Elective	244321	Use elementary electronics as applied to electronic systems	Level 3	NQF Level 03	4
Elective	337139	Conduct sound measurement	Level 4	NQF Level 04	10
Elective	116329	Determine common electronic faults and conduct generic electronic tests	Level 4	NQF Level 04	3
Elective	119256	Inspect and test electrical circuits	<p>This qualification is the result of the combined review process which considered the following qualifications and replaces the following:</p> <ul style="list-style-type: none"> □ ID 48475: National Certificate: Electrical Engineering NQF Level 3. □ ID 13640: Chemical Electrical NQF Level 3. <p>A generic qualification was developed to give meaning to NQF objectives to provide articulation possibilities, enable learners to get recognition for learning achievements across economic sub-sectors and to support the notion of life long learning.</p>		

UNIT STANDARDS:

	ID	UNIT STANDARD TITLE	PRE-2009 NQF LEVEL	NQF LEVEL	CREDITS
Core	259078	Install and commission electrical metering units, measuring instruments and control devices	Level 2	NQF Level 02	8
Core	10270	Construct Basic Electronic Circuits	Level 3	NQF Level 03	4
Core	258966	Inspect and test a single phase domestic installation	Level 3	NQF Level 03	10
Core	259077	Install and commission direct-on-line AC rotating machines and control gear	Level 3	NQF Level 03	10
Core	25903	Maintain and repair direct-on-line	Level 3	NQF	8

	8	AC rotating machines and control gear		Level 03	
Core	258965	Maintain lighting systems	Level 3	NQF Level 03	4
Core	9530	Manage work time effectively	Level 3	NQF Level 03	3
Core	258959	Operate on Low Voltage networks	Level 3	NQF Level 03	12
Core	258961	Repair and maintain electric power tools	Level 3	NQF Level 03	6
Core	258977	Understand basic electronic theory and components	Level 3	NQF Level 03	4
Core	258968	Wire and commission domestic or commercial electrical circuits	Level 3	NQF Level 03	8
Fundamental	119472	Accommodate audience and context needs in oral/signed communication	Level 3	NQF Level 03	5
Fundamental	9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	Level 3	NQF Level 03	2
Fundamental	9013	Describe, apply, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts	Level 3	NQF Level 03	4
Fundamental	119457	Interpret and use information from texts	Level 3	NQF Level 03	5
Fundamental	9012	Investigate life and work related problems using data and probabilities	Level 3	NQF Level 03	5
Fundamental	119467	Use language and communication in occupational learning programmes	Level 3	NQF Level 03	5
Fundamental	7456	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	Level 3	NQF Level 03	5
Fundamental	119465	Write/present/sign texts for a range of communicative contexts	Level 3	NQF Level 03	5

Elective	265005	Demonstrate an understanding of switchgear assembly	Level 2	NQF Level 02	3
Elective	244077	Demonstrate understanding of chemicals in a processing environment	Level 2	NQF Level 02	6
Elective	10244	Maintain and repair a high voltage security fence system	Level 2	NQF Level 02	4
Elective	258918	Select, use and care for electrical measuring and testing instruments	Level 2	NQF Level 02	4
Elective	116937	Use a Graphical User Interface (GUI)-based spreadsheet application to create and edit spreadsheets	Level 2	NQF Level 02	4
Elective	264997	Assemble switchgear assembly	Level 3	NQF Level 03	12
Elective	259097	Carry out a detailed inspection and repair defects on explosion prevention apparatus	Level 3	NQF Level 03	6
Elective	258969	Construct, maintain and dismantle Medium Voltage overhead networks	Level 3	NQF Level 03	14
Elective	116674	Demonstrate an understanding of energy efficiency	Level 3	NQF Level 03	4
Elective	265007	Demonstrate knowledge of legislation and standards relevant to the switchgear assembly industry	Level 3	NQF Level 03	3
Elective	265034	Demonstrate knowledge of switchgear assembly components and their representation on drawings	Level 3	NQF Level 03	8
Elective	259037	Design and install electrical wire ways	Level 3	NQF Level 03	8
Elective	265002	Fabricate and install busbars	Level 3	NQF Level 03	8
Elective	113869	Fault find a photovoltaic supplied system	Level 3	NQF Level 03	8
Elective	258924	Fault Find, Test and Repair Domestic Appliances	Level 3	NQF Level 03	6
Elective	113875	Inspect, operate and maintain high mast lighting structures	Level 3	NQF Level	7

				03	
Elective	258964	Inspect, test and maintain earthing and negative return systems on 3-kV DC traction substations	Level 3	NQF Level 03	7
Elective	116678	Install and maintain a solar hot water system	Level 3	NQF Level 03	5
Elective	258963	Install and maintain an electrical supply unit in a production section	Level 3	NQF Level 03	5
Elective	258997	Install batteries	Level 3	NQF Level 03	4
Elective	264999	Install earthing systems and shrouding on switchgear assembly	Level 3	NQF Level 03	4
Elective	114660	Install Medium Voltage transformers	Level 3	NQF Level 03	6
Elective	258958	Install or replace mini substations and ring-main units/switches	Level 3	NQF Level 03	6
Elective	258930	Isolate a three-phase transformer and carry out tap changes	Level 3	NQF Level 03	2
Elective	259057	Maintain the electrical system of a surface mining production machine	Level 3	NQF Level 03	5
Elective	259018	Maintain the electrical system of conveyor installations	Level 3	NQF Level 03	5
Elective	258940	Maintain the electrical system of winder installations	Level 3	NQF Level 03	5
Elective	265008	Modify installed switchgear assemblies	Level 3	NQF Level 03	4
Elective	265014	Perform production testing of switchgear assembly	Level 3	NQF Level 03	4
Elective	259058	Perform work on energised Low Voltage networks	Level 3	NQF Level 03	8
Elective	259117	Test and maintain electrical mini substations	Level 3	NQF Level 03	3
Elective	25893	Test, diagnose and locate a fault on	Level 3	NQF	9

	3	a high voltage electrical cable		Level 03	
Elective	262924	Use and care for medium voltage electrical test instruments	Level 3	NQF Level 03	4
Elective	114594	Apply the principles of costing and pricing to a business venture	Level 4	NQF Level 04	6
Elective	113898	Complete certificate of compliance for a single phase domestic installation	Level 4	NQF Level 04	5
Elective	114598	Demonstrate an understanding of an entrepreneurial profile	Level 4	NQF Level 04	5
Elective	265015	Demonstrate knowledge of busbar design	Level 4	NQF Level 04	4
Elective	113884	Fault find and repair a stand-alone battery charging wind turbine	Level 4	NQF Level 04	5
Elective	117156	Interpret basic financial statements	Level 4	NQF Level 04	4
Elective	113885	Lower, inspect service and maintain a stand-alone battery charging wind turbine	Level 4	NQF Level 04	5
Elective	114586	Manage finances of a new venture	Level 4	NQF Level 04	5
Elective	113900	Operate on Medium Voltage radial networks	Level 4	NQF Level 04	20
Elective	114592	Produce business plans for a new venture	Level 4	NQF Level 04	8
Elective	114593	Tender to secure business for a new venture			

Earn a career certificate

Add this credential to your LinkedIn profile, resume, or CV

Share it on social media and in your performance review

Professional Certificate - 7 course series

Prepare for a new career in the high-growth fields of digital marketing and e-commerce, in under six months, no experience or degree required. Businesses need digital marketing and e-commerce talent more than ever before; [86% of business leaders](#)

- report that digit

Graduate Certificates

- [Graduate Degrees](#)
- Graduate Certificates
- [Undergraduate Degree and Certificates](#)
- [Microcertificates](#)
- [Our Faculty](#)

Develop new skills and build expertise in a specialized area to advance your career. Nearly 90% of our certificate earners report that they are confident that their certificate has prepared them for their next step. Explore your graduate certificate options below.

How do I get started pursuing a certificate?

To learn more about getting started on a certificate, joining virtual office hours, and using student resources, visit [Pursuing a Certificate](#).

Is a graduate certificate useful?

Harvard Extension students most often report pursuing a graduate certificate to deepen their professional expertise and advance in their current career. A certificate is ideal for people attempting to move up in their current field. The courses can be completed on a part-time basis, allowing many to continue working full time. In fact, many students reported achieving their goals while still in the program.

In a survey of 1,000 students who had just completed their certificate program, 42 percent said they took on more responsibilities at work, received a promotion, or changed careers while pursuing the credential. Read more about the [value of a graduate certificate](#).

Can I earn a graduate certificate while earning a master's degree?

Yes! Earning a graduate certificate can be a great first step toward earning a master's degree. At Harvard Extension School, 44% of certificate earners choose this route, affording them the benefits of both credentials.

Most of our certificates stack toward at least one [Master of Liberal Arts \(ALM\) degree](#). You can earn a graduate certificate on your way to a master's degree by choosing courses required for a certificate that also count toward a related master's.

For prospective students having trouble deciding between a degree and a certificate, stackable credentials make it easy to start with smaller goals before making the leap to a master's.

Master Class Series

The Master Class Series is an initiative of The Center for Teaching Excellence to provide specialized instruction to faculty members on a specific pedagogy. The Master Class Series is designed to bring faculty and instructors together who are interested in exploring ways to advance their teaching or learning new methods in a specific area. The Master Class is led by a "Master Instructor" who has been identified as an expert on the topic.

Each semester a new Master Class Series topic is offered. The topic for the Fall 2021 Master Class is "Tweaking to Improve Planning and Assessment of Student Learning" facilitated by "Master Instructor" Nate Carnes, Associate Professor and Associate Director of the Center for Teaching Excellence

Master Class Series Requirements

Faculty and instructors must apply for consideration for the Master Class Series. Faculty and instructors who are accepted into the Master Class Series must agree to attend prescheduled Master Class session. The Master Class Series is scheduled in advance and is listed below. To receive a Master Class certificate of completion, faculty and instructors must attend all three sessions.

Master Class participants are expected participate in each session by engaging in seminar discussion, group discussion and completing assignments. Accepted faculty and instructors will be provided a letter of intent once they are accepted into the Master Class. The master class series will be offered virtually and is accessible through Blackboard Collaborate. The Blackboard Collaborate link will be provided to master class participants.

Any faculty member at USC-Columbia, Palmetto College regional campuses or USC Schools of Medicine (Greenville and Columbia) are eligible to apply for the Master Class Series. This program is not open to graduate students nor adjunct instructors.

Master Class Applications for Fall 2021 are no longer being accepted. Check back to apply for the Spring 2022 Cohort.

Master Class Series Fall 2021 : Tweaking to Improve Planning and Assessment of Student Learning

Fall 2021 Schedule

Planning and Assessing: What it Entails

Thursday, October 28, 2021 - 2:50 pm - 4:05 pm

During the first session, we will start with a short history of objectives in education, acknowledging the lack of understanding of objectives in terms of intended student learning until Bloom's Taxonomy came into existence. Through brief presentations of

learning outcomes embedded within our own syllabi, we will engage in discussions and reflections that lead to views of our existing knowledge and practices as they relate to planning and assessment of student learning. These interactions will establish baselines for growth.

Revised Bloom's Taxonomy: What It Is and Isn't

Thursday, November 18, 2021 - 2:50 pm - 4:05 pm

An Internet search for the revised Bloom's taxonomy and ways in which it is depicted yields a wide variety of models and diagrams. Drawing from *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (Anderson et al, 2000), we will view/review the vision that Bloom's former doctoral students had for revising the original taxonomy. With this knowledge, we will evaluate the various models and illustrations that populate the Internet and assess the accuracies of their depictions. Also, we will discuss the implications that the revised Bloom's taxonomy has for how we plan for learning outcomes in our respective courses.

Applications of the Revised Bloom's Taxonomy

Thursday, December 9, 2021 - 2:50 pm - 4:05 pm

In this session, we will engage in a practice session of writing learning outcomes and apply the use of the revised Bloom's taxonomy as an analytic tool, giving careful attention to the matrix that we received during the second session. Its purpose does not serve as an aid for writing learning outcomes, but to analyze objectives once they are written. In the spirit of a learning celebration, we will reflect on our experiences throughout this Master Class Series with a focus on how we might get better at communicating our expectations for learning in our respective courses. We will end by revisiting baselines that we set in Session I, citing insights that we have made to better articulate expectations for learning.

About the Facilitator

Nate Carnes is the Associate Director of the Center for Teaching Excellence and an associate professor in the College of Education. Among his several education affiliations, he is a former board member and an active member of the Association for Science Teacher Education, a non-profit professional organization composed of over 500 members across the United States and countries around the globe. His teaching performances, that span more than 40 years, have resulted in awards and citations of teaching excellence at the University of South Carolina, state, regional and international levels. Carnes has interacted with Dr. Lorin Anderson, a Carolina Distinguished Professor Emeritus and former student of Benjamin Bloom, on several occasions to gain a

What Career and Technical Education Teachers Do [About this section](#)

Technical education teachers often work in classrooms and help students.

Career and technical education (CTE) teachers provide training in subjects such as auto repair, cosmetology, and culinary arts. They teach vocational and technical content to give students the skills and knowledge necessary to enter an occupation.

Duties

Career and technical education teachers typically do the following:

- Create lesson plans and assignments
- Instruct students on how to develop certain skills
- Show students how to apply classroom knowledge through hands-on activities
- Demonstrate and supervise safe and proper use of tools and equipment
- Monitor students' progress, assign tasks, and grade assignments
- Discuss students' progress with parents, students, and counselors
- Develop and enforce classroom rules and safety procedures

CTE teachers help students explore and prepare to enter a career or technical occupation. They use a variety of teaching methods to help students learn and develop skills related to a specific occupation or career field. They demonstrate tasks, techniques, and tools used in an occupation. They may assign hands-on tasks, such as replacing brakes on cars, taking blood pressure, or applying makeup. Teachers typically oversee these activities in workshops and laboratories in the school.

Some teachers work with local businesses and nonprofit organizations to provide practical work experience for students. They also serve as advisers to students participating in career and technical student organizations.

The specific duties of CTE teachers vary by the grade and subject they teach. In middle schools and high schools, they teach general concepts in a classroom and practical exercises in workshops and laboratories.

In postsecondary schools, they teach specific career skills that help students earn a certificate, a diploma, or an associate's degree and prepare them for a specific job. For example, welding instructors teach students welding techniques and safety practices. They also monitor the use of tools and equipment and have students practice procedures until they meet the standards required by the trade.

In most states, teachers in middle and high schools teach one subject within major career fields. CTE teachers combine academic instruction with experiential learning in their subject of expertise.

For example, teachers of courses in ***agricultural, food, and natural resources*** teach topics such as agricultural production; agriculture-related business; veterinary science; and plant, animal, and food systems. They may have students plant and care for crops and animals to apply what they have learned in the classroom.

For information about the programs for major career fields, visit [Advance CTE](#).

Job Outlook [About this section](#)

Career and Technical Education Teachers

Percent change in employment, projected 2022-32

Total, all occupations

3%

Educational instruction and library occupations

2%

Career and technical education teachers

0%

Note: All Occupations includes all occupations in the U.S. Economy.

Source: U.S. Bureau of Labor Statistics, Employment Projections program

Overall employment of career and technical education teachers is projected to show little or no change from 2022 to 2032.

Despite limited employment growth, about 14,800 openings for career and technical education teachers are projected each year, on average, over the decade. Most of those openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Employment

Some demand for these workers is expected over the projections decade due to continued interest in career and technical education programs in middle schools, high schools, and

postsecondary institutions. However, this demand is likely to be tempered as schools continue to require students to take more academic classes.

In addition, public schools often depend on government funding for career and technical education programs. When budgets for these programs are reduced, employment growth for career and technical education teachers may be limited.

Employment projections data for career and technical education teachers, 2022-32

Occupational Title	SOC Code	Employment, 2022	Projected Employment, 2032	Change, 2022-32 Percent	Numerical	Employment by Industry
Career and technical education teachers	—	212,100	211,300	0	-800	—
Career/technical education teachers, postsecondary	25-1194	113,000	112,500	0	-600	Get data
Career/technical education teachers, middle school	25-2023	11,100	11,100	0	0	Get data
Career/technical education teachers, secondary school	25-2032	88,000	87,700	0		

SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program

interpretation, analyse and apply current legislation and departmental policies, organizational skills, decision-making skills, and proven written and verbal skills. Attention to detail and high level of accuracy, effective public relations, and public speaking. Computer literacy with specific reference to functional MS Excel, MS Word, MS PowerPoint, and MS Outlook. Willingness to travel and a valid driver's licence.

DUTIES: Manage, conduct, and coordinate curriculum and support processes in the region. Write reports to go to institutions and compile regional reports. Conduct regular on-site visits to CLCs. Identify gaps in evaluated institutions and develop intervention strategies to improve teaching and learning support services. Communicate the identified curricular gaps in institutions to the CET college. Manage, monitor, evaluate and coordinate curriculum implementation and support CLCs. Work collaboratively to improve student performance. Establish systems and structures that allow effective management. Assist the deputy director to establish channels of communication with relevant stakeholders. Manage information by collecting, analysing, and translating data into knowledge for planning, decision making and reporting. Facilitate policy formulation, analysis, and implementation. Provide management and support in line with approved Strategic and Annual Performance Plans. Undertake research and development to improve teaching and learning support to CET institutions in the region. Ensure proper record-keeping, control, and reporting. Conduct student enrolment verification. Assist the CET college to conduct unit-level records and annual surveys. Perform any other reasonable function assigned by the e

Critical Skills Work Visa will enable the Department and the government to achieve the objectives of programmes such as National Development Plan (NDP), Industrial Policy Action Plan (IPAP) and New Growth Plan (NGP). The Department of Home Affairs has amended the Immigration legislation that came with various changes, which led to the introduction of Critical Skills Work Visa (CSWV).

The Critical Skills Work Visa emanates from the merger of the former Exceptional Skills and Quota Work visas. The latter was issued in line with the Quota List of 2009, which had skills categories, requirements, and the quota of skills targeted in the Republic of South Africa. The Critical Skills work visa is issued in accordance with the [critical skills list](#). The list was developed in conjunction with the occupations in high demand and the scarce skills lists of the Department of Higher Education and Training (DHET). The main objective of the critical skills work visa is to assist the government to realise the achievement of the National Infrastructure Project, the Strategic Infrastructure Projects and Key National Strategic Projects in support of the Department of Trade and Industry.

REQUIREMENTS FOR A CRITICAL SKILLS WORK VISA

Section 19(4) of the ACT

- ***Duly completed online form. Handwritten forms will not be accepted by department of home affairs.***
- Passport valid for no less than 30 calendar days after expiry of the intended visit.
- A medical report not older than 6 months
- A radiological report not older than 6 months
- Marriage certificate or in the case of a foreign spousal relationship, proof of official recognition thereof issued by the authorities of the foreign country of the applicant (where applicable).
- The affidavit where a spousal relationship to a South African citizen or resident is applicable as well as documentation proving cohabitation and the extent to which the related financial responsibilities are shared by the parties and setting out the particulars of children in the spousal relationship.
- Proof of a union recognised in terms of the recognition of customary marriages act, 1998 (act no. 120 of 1998), where applicable.
- Divorce decree, where applicable.
- Proof of court order awarding custody, where applicable.
- Death certificate, in respect of late spouse, where applicable.
- Written consent from both parents and/or sole custody parent, where applicable, with proof of sole custody.
- Proof of legal adoption where applicable.
- Legal separation order, where applicable.
- Police clearance certificate issued by the police or security authority in each country where the relevant applicant resided for 12 months or longer after attaining the age of 18 years, in respect of criminal records or the character of that applicant, which certificate shall not be older than six months at the time of its submission: (provided that the certificate shall not be required from a foreign country in the case of renewal or extension of a visa but from the republic)
- A yellow fever vaccination certificate if that person travelled or intends travelling from or transiting through a yellow fever endemic area: (provided that the certificate shall not be required where that person travelled or intends travelling in direct transit through such area)
- A written undertaking by the employer accepting responsibility for the costs related to the deportation of the applicant and his or her dependent family members, should it become necessary (where there is no employer: proof of sufficient financial means to the value of a minimum of r3 000 in the form of three months bank statements)
- A written undertaking by the employer to ensure that the passport of his or her employee is valid at all times for the duration of his or her employment (where there is no employer: a written undertaking by the applicant to ensure that the passport of the applicant shall be valid at all times for the duration of his or her temporary visa)
- Proof that the applicant falls within the critical skills category by specifically indicating the occupation/critical skill for which the application is being made. The occupation/critical skill must be on the critical skills list.
- Proof of evaluation of the foreign qualification by **SAQA** and translated by a sworn translator into one of the official languages of the republic.
- If required by law, proof of application for a certificate of registration with the **professional body**, council or board recognised by SAQA in terms of section 13(1)(i) of the national qualifications framework act;
- A confirmation, in writing, from the professional body, council or board recognised by saqa in terms of section 13(1)(0 of the national qualifications framework act, or any **relevant government department** confirming the skills or qualifications of the

applicant and appropriate post qualification experience, (if not attached, VFS official to check directive 22 of 2014)

- Proof of payment of the applicable fee

CRITICAL SKILLS WORK VISA - RENEWAL

SECTION 19(4) OF THE ACT

- Duly completed online form. Handwritten forms will not be accepted by department of home affairs.
- Passport valid for no less than 30 calendar days after expiry of the intended visit.
- A medical report not older than 6 months
- A radiological report not older than 6 months
- Marriage certificate or in the case of a foreign spousal relationship, proof of official recognition thereof issued by the authorities of the foreign country of the applicant (where applicable).
- The affidavit where a spousal relationship to a south african citizen or resident is applicable as well as documentation proving cohabitation and the extent to which the related financial responsibilities are shared by the parties and setting out the particulars of children in the spousal relationship.
- Proof of a union recognised in terms of the recognition of customary marriages act, 1998 (act no. 120 of 1998), where applicable.
- Divorce decree, where applicable.
- Proof of court order awarding custody, where applicable.
- Death certificate, in respect of late spouse, where applicable.
- Written consent from both parents and/or sole custody parent, where applicable, with proof of sole custody.
- Proof of legal adoption where applicable.
- Legal separation order, where applicable.
- Police clearance certificate issued by the police or security authority in each country where the relevant applicant resided for 12 months or longer after attaining the age of 18 years, in respect of criminal records or the character of that applicant, which certificate shall not be older than six months at the time of its submission: (provided that the certificate shall not be required from a foreign country in the case of renewal or extension of a visa within the republic)
- A yellow fever vaccination certificate if that person travelled or intends travelling from or transiting through a yellow fever endemic area: (provided that the certificate shall not be required where that person travelled or intends travelling in direct transit through such area)
- A written undertaking by the employer accepting responsibility for the costs related to the deportation of the applicant and his or her dependent family members, should it become necessary (all renewals must be accompanied by an offer of employment or employer contact. no renewal without employment contract except for the occupations listed under the category of life and earth sciences and academics and researchers)
- A written undertaking by the employer to ensure that the passport of his or her employee is valid at all times for the duration of his or her employment (where there is no employer: a written undertaking by the applicant to ensure that the passport of the applicant shall be valid at all times for the duration of his or her temporary visa)

- For the occupations listed under the category of life and earth sciences and academics and researchers, where there is no employment contract, proof of financial means. (applicant to also submit additional proof of financial means every 12 months thereafter)
- Proof that the applicant falls within the critical skills category by specifically indicating the occupation/critical skill for which the application is being made as it appears on the critical skills list.
- Proof of evaluation of the foreign qualification by **SAQA** and translated by a sworn translator into one of the official languages of the republic.
- If required by law, proof of application for a certificate of registration with the professional body, council or board recognised by SAQA in terms of section 13(1)(i) of the national qualifications framework act;
- A confirmation, in writing, from the professional body, council or board recognised by saqa in terms of section 13(1)(0 of the national qualifications framework act, or any relevant government department confirming the skills or qualifications of the applicant and appropriate post qualification experience, (if not attached, VFS official to check directive 22 of 2014)
- Proof of payment of the applicable fee

CRITICAL SKILLS WORK VISA (EXTENSION OF VISA INITIALLY ISSUED FOR 12 MONTHS)

SECTION 19(4) OF THE ACT

- Duly completed online form. Handwritten forms will not be accepted by Department of Home Affairs.
- Passport valid for no less than 30 calendar days after expiry of the intended visit.
- Police clearance certificate (Not required if person has been in the Republic for less than 12 months at the time of extension)
- Contract of Employment or Offer of Employment signed by both applicant and the employer stating the condition that the contract will only be valid provided the applicant obtains a valid critical skills work visa)
- A written undertaking by the employer accepting responsibility for the costs related to the deportation of the applicant and his or her dependent family members, should it become necessary
- A written undertaking by the employer to ensure that the passport of his or her employee is valid at all times for the duration of his or her employment
- Proof that the applicant falls within the critical skills category by specifically indicating the occupation/critical skill for which the application is being made. The occupation/critical skill must be on the **Critical Skills list**.
- Copy of the Critical Skills Work Visa recently issued to the applicant for 12 months.

